# Two faces of polar climate change

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The rate of warming of Arctic surface temperature is about 2-3 times faster than the global mean surface warming. Increases of ice albedo feedback and water vapor as well as moisture intrusion from outside the Arctic all have major roles in this phenomenon. In contrast to this rapid Arctic warming, in recent decades, stronger cold air outbreaks have occurred more frequently during winter in East Asia than were recorded in the 1990s, resulting in severe socioeconomic impacts. A number of related studies have claimed that the increased frequency of these stronger cold air outbreaks is linked to the amplified warming in the Arctic through complicated mechanisms. As there are time lags between the observed Arctic warming and East Asian cold weather response at various scales, understanding the entire chain of processes from the Arctic to East Asia has importance for forecasting winter weather in East Asia. There are two pathways linking Arctic warming with East Asian cold weather events. One is the synoptic-scale pathway in the lower troposphere via strengthening of the Siberian High initiated by Ural blocking. The other is the planetary-scale path through the stratosphere via activation of planetary waves and downward propagation, which weakens the polar vortex. This study briefly reviews the current understanding of the linkage mechanisms between Arctic warming and East Asian winter cold weather.

In contrast to the fast Arctic warming, the climate change in the Antarctic is different regionally. In the Antarctic peninsular and west Antarctica, the marked warming has been observed. However, in east Antarctica, there is little warming and even a slight cooling is found, especially in the Weddell Sea sector. The sea ice and ice sheet changes are consistent with the temperature responses. That is, in the Bellingshausen and Amundsen Seas, sea ice melting is ongoing, but in the east Antarctic sector, especially in the Ross and Weddell Seas, sea ice has shown an increasing trend. The ice sheet melting is large in west Antarctica, whereas there is little change in ice sheet in eastern part. Then, what would be the cause for the regionally different climate responses? The strengthening of the polar vortex in the southern hemisphere associated with the stratospheric ozone reduction seems to be responsible for such regionally different responses. The strengthening of the Amundsen Sea Low pressure is also responsible for the warming over the Antarctic Peninsula, while a slight cooling over eastern Antarctica.

In conclusion, in both hemispheres, the change in polar vortices, i.e., the weakening in the Arctic and strengthening in Antarctica associated with greenhouse gas increase and ozone reduction seem to be responsible for the recent contrasting bi-polar climate responses.